commodore

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MAX MACHINE SOFTWARE DEVELOPMENT GUIDE

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SECTION I: OVERVIEW

Introduction

The following information kit has been designed to help you develop software (games) for the new **COMMODORE MAX MACHINE.** The information contained in this kit is confidential and must not be shown, copied, or transfered without prior written permission from Commodore (per the nondisclosure clause in your development contract).

Recommended Hardware

1. Commodore CBM Model 8032 computer
2. Commodore CBM Model 4040 disk drive
3. Commodore 64 computer
4. Commodore 1540 disk drive
5. VicMon 40 expander cartridge
6. Commodore printer

Software Development Guidelines

1. A storyboard or outline must be submitted for all software projects, prior to contract.

2. Project liason: You will be given the name of a technical programming contact at Commodore to help answer your technical questions.

3. Programs submitted for approval must be accompanied by the following:

Commented Source Listing
Source Disk
Object Files
Program & Draft Documentation
Game Instructions

COMMODORE ULTIMAX GAME DEVELOPMENT NOTES:

The Commodore ULTIMAX is an advanced, full-featured: game machine, music machine and with BASIC language cartridge you can learn BASIC programming.

Without a program cartridge the ultimax is useless, the internals of the machine consist of a 6510 microprocessor, a 6526 I/O chip, a 6567 color video processor chip, a 6581 synthesizer chip and 2.5K of RAM (1K bytes for zero-page stack and data storage, 1K bytes for screen and 1K nibbles for color.

THERE IS NO ROM IN THE ULTIMAX !!!!!!!

GAME WRITING SUGGESTIONS:

Although the Ultimax cartridges can contain up to 16K ROM and 2K additional RAM, games should by no means exceed 8K ROM with no additional RAM.

The 8K space will be addressed from $E000-FFFF so the cartridge will be directly responsible for the machine's behavior on power-up (RES), etc.

The 6567 video processor only looks at the lowest 16K of the Ultimax memory map, so a shadow of the $F000-FFFF block appears in $3000-3FFF, all character and/or sprite data must appear in this area. (note:character sets can only begin on 2K boundaries)

GAME CONTROLLERS:

Joysticks: Up to 2 can be used simultaneously and are mapped at $DC00(joy a) & $DC01(joy b). normally bits 0-4 are set, unset bits are decoded as follows:

bit 0	forward
bit 1	back
bit 2	left
bit 3	right
bit 4	fire

Paddles: There are only 2 A/D converters in the Ultimax which are located at $D419 for paddle x and $D41a for paddle y, but we can multiplex between the two game ports and decode up to 4 paddles by manipulating $DC00 bits 6 and 7. When 6 is high and 7 is low, port a is active, when 7 is high and 6 is low port b is active. The paddle fire buttons are decoded on $DC00- bit 2 is paddle x fire button and bit 3 is paddle y fire button.

NOTE: CARE SHOULD BE TAKEN THAT PADDLE MULTIPLEX IS RESET WHEN NOT IN USE SO THAT KEYBOARD SCAN IS NOT INTERFERED WITH.

SECTION II: MAX SOFTWARE DEVELOPMENT

Max Technical Overview

FEATURES:

6510 MICROPROCESSOR: 6502 COMPATIBLE

6566 VIDEO DISPLAY CHIP:
* 320 X 200 PIXEL RESOLUTION
* 16 COLORS AVAILABLE SIMULTANEOUSLY
* INDEPENDENTLY MOVEABLE DISPLAY OBJECTS
  - EACH OBJECT IS 24 X 21 PIXELS
  - COLLISION DETECTION BETWEEN OBJECTS
  - SELECTABLE OBJECT DISPLAY PRIORITY
  - MULTICOLOR OBJECTS
* HORIZONTAL OR VERTICAL SCROLLING BY PIXEL

6581 SID SOUND SYNTHESIZER CHIP
* 3 INDEPENDENT VOICES, EACH WITH:
  - 9 OCTAVE RANGE (.059Hz-3.9KHz IN .059Hz STEPS)
  - 4 WAVEFORMS: SAWTOOTH, TRIANGLE, VARIABLE PULSE, AND NOISE
  - AMPLITUDE MODULATION
  - PROGRAMMABLE ADSR ENVELOPE GENERATOR
  - RING MODULATION
  - OSCILLATOR SYNCHRONIZATION
* PROGRAMMABLE FILTER
  - INDEPENDENTLY SELECTABLE FOR EACH VOICE
  - LOW PASS, HIGH PASS, BAND PASS, AND NOTCH OUTPUTS
  - VARIABLE RESONANCE
* MASTER VOLUME CONTROL

DESIGN FEATURES:

KEYBOARD:
- FLAT MEMBRANE KEYBOARD

GAME CONTROLLERS:
- JOYSTICKS
- PADDLES
- LIGHT PEN

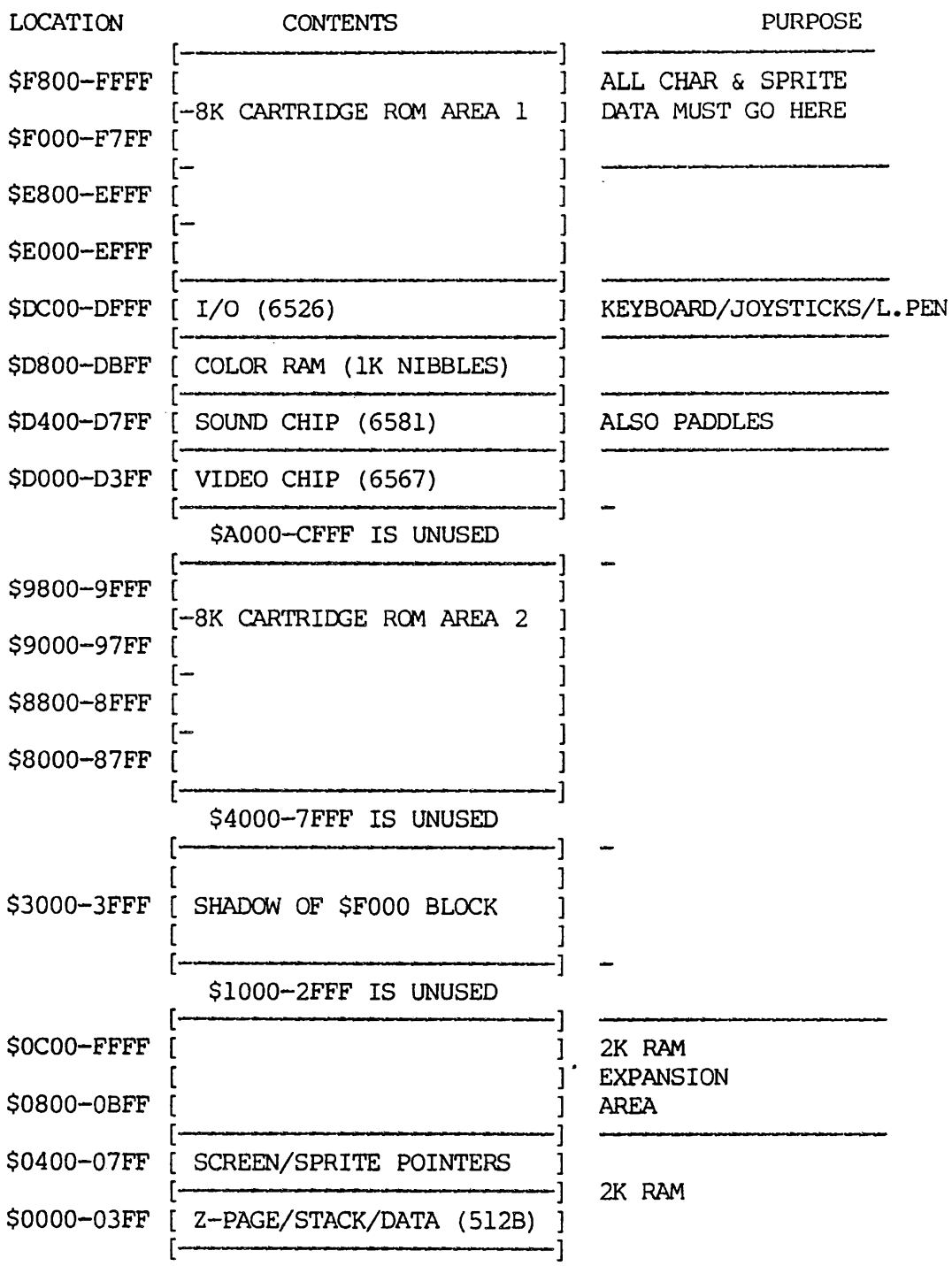
PLUG-IN CARTRIDGE:
- CARTRIDGES CAN ALSO BE RUN ON COMMODORE 64

I/O SYSTEMS:
- CBM CASSETTE INTERFACE
- 44 PIN EXPANSION BUS/CARTRIDGE SLOT
- RF MODULATOR WITH SOUND FOR TV HOOKUP
- 75 OHM COMPOSITE VIDEO OUTPUT FOR MONITOR
- AUDIO OUTPUT FROM SYNTHESIZER

MEMORY CONFIGURATION:
- 1K SCREEN RAM
- 1K USER RAM
- 2K RAM EXPANSION
- 1K COLOR RAM-NIBBLES

ACCESSORIES:
- BASIC LANGUAGE CARTRIDGE
- PLUG-IN GAME AND APPLICATION CARTRIDGES
- JOYSTICKS
- PADDLES
- LIGHT PEN
- CASSETTE UNIT

COMMODORE ULTIMAX FUNCTIONAL DIAGRAM:



NOTE:

THERE IS <NO> ROM IN THIS UNIT, THEREFORE ALL CHARACTER DATA MUST COME FROM THE CARTRIDGE.

THE 6510 VECTOR INFORMATION (IRQ/RES/NMI) WILL BE TAKEN FROM THE TOP OF CARTRIDGE ROM #1.

Max Memory Map, March 10, 1982

LOCATION		DESCRIPTION
HEX	DECIMAL	
0000-07FF (0400)	0-2047	2K RAM (2K) SCREEN
0800-0FFF	2048-4095	2K EXPANSION RAM (2K)
1000-13FF	4096-5119	6566 VIDEO CHIP
1400-17FF	5120-6143	6581 (SID) SYNTHESIZER CHIP
1800-1BFF	6144-6655	1K COLOR NIBBLE
1C00-1FFF	6656-8191	6526 (CIA) I/O CHIP
2000-3FFF	8192-16383	8K CARTRIDGE ROM AREA

SECTION III: C-64 SOFTWARE DEVELOPMENT

C-64 Technical Overview

FEATURES:

6510 MICROPROCESSOR: 6502 SOFTWARE COMPATIBLE

6566 VIDEO DISPLAY CHIP:

* 40 COLUMN BY 25 LINE CHARACTER DISPLAY WITH INDEPENDENT FOREGROUND AND BACKGROUND COLORS
* USER PROGRAMMABLE CHARACTERS
* 320 X 200 PIXEL COLOR BIT-MAP, 2 COLORS PER 8 X 8 PIXEL ZONE
* 160 X 200 PIXEL 'MULTI-COLOR' BIT-MAP, 4 COLORS PER 8 X 4 PIXEL ZONE
* 16 COLORS AVAILABLE SIMULTANEOUSLY
* INDEPENDENTLY MOVEABLE DISPLAY OBJECTS
  - EACH OBJECT IS 24 X 21 PIXELS
  - COLLISION DETECTION BETWEEN OBJECTS
  - SELECTABLE OBJECT DISPLAY PRIORITY
  - MULTICOLOR OBJECTS
* HORIZONTAL OR VERTICAL SCROLLING BY PIXEL

6581 SID SOUND SYNTHESIZER CHIP

* 3 INDEPENDENT VOICES, EACH WITH:
  - 9 OCTAVE RANGE (.059Hz-3.9KHz in .059Hz steps)
  - 4 WAVEFORMS: SAWTOOTH, TRIANGLE, VARIABLE PULSE, AND NOISE
  - AMPLITUDE MODULATION
  - PROGRAMMABLE ADSR ENVELOPE GENERATOR
  - RING MODULATION
  - OSCILLATOR SYNCHRONIZATION
* PROGRAMMABLE FILTER
  - INDEPENDENTLY SELECTABLE FOR EACH VOICE
  - LOW PASS, HIGH PASS, BAND PASS, AND NOTCH OUTPUTS
  - VARIABLE RESONANCE
* MASTER VOLUME CONTROL

DESIGN FEATURES:

KEYBOARD:
- 66 KEY FULL-STROKE
- CHARACTER COLORS SELECTABLE DIRECTLY FROM KEYBOARD

GAME CONTROLLERS:
- JOYSTICKS
- PADDLES
- LIGHT PEN

PLUG-IN CARTRIDGE:
- COMPATIBLE WITH COMMODORE ULTIMAX CARTRIDGES

I/O SYSTEMS:
- 8 BIT USER PORT
- CBM SERIAL BUS
- CBM CASSETTE INTERFACE
- 44 PIN EXPANSION BUS/CARTRIDGE SLOT
- RF MODULATOR WITH SOUND FOR TV HOOKUP
- 75 OHM COMPOSITE VIDEO OUTPUT FOR MONITOR
- AUDIO OUTPUT FROM SYNTHESIZER

MEMORY CONFIGURATION:
- 1K SCREEN RAM
- 1K COLOR RAM-NIBBLES
- 52K MACHINE LANGUAGE USER RAM
  (38K BASIC USER RAM)
- 8K BASIC ROM
- 8K KERNAL ROM
- 4K CHARACTER ROM

ACCESSORIES:
- PLUG-IN GAME AND APPLICATION CARTRIDGES
- SINGLE DISK DRIVE (170K)
- TRACTOR FEED IMPACT GRAPHICS PRINTER
- DIRECT CONNECT MODEM
- RS-232 CARTRIDGE
- IEEE CARTRIDGE
- JOYSTICKS
- PADDLES
- LIGHT PEN
- CASSETTE UNIT

FUTURE ACCESSORIES:

- Z-80 MICROROCESSOR CARD
- SOFT LOADED LANGUAGES:
  * CBM BASIC 4.0
  * UCSD PASCAL
- SUPPORT FOR:
  * FORTH
  * PILOT

- EXTENDED BASIC ROM CARTRIDGE
  * BASIC GRAPHIC COMMANDS
  * BASIC SOUND/MUSIC COMMANDS

- PROGRAMMER'S AID CARTRIDGE
  * ENHANCED EDITOR
  * PROGRAM TRACE
  * RENUMBER

- EXTENDED MACHINE LANGUAGE MONITOR ROM CARTRIDGE
  * MONITOR
  * DEBUGGER
  * ASSEMBLER
  * DISASSEMBLER

C-64 Memory Map

LOCATION		DESCRIPTION
HEX	DECIMAL	
0000-03FF	0-1023	ZERO PAGE/BASIC POINTERS/STACK/ETC.
0400-07FF	1024-2047	SCREEN RAM
0800-9FF	2048-40959	PROGRAM TEXT AREA
8000-9FFF	32768-40959	8K CARTRIDGE ROM AREA
A000-BFFF	40960-49151	8K BASIC (V2)
C000-CFFF	49152-53247	4K RAM
D000-D3FF	53248-54271	6566 VIDEO CHIP
D400-D7FF	54242-55295	6581 (SID) SYNTHESIZER CHIP
D800-DBFF	55296-56319	1K COLOR NIBBLE
DC00-DCFF	56320-56575	6526 #1 (CIA) I/O CHIP
DD00-DDFF	56576-56831	6526 #2 (CIA) I/O CHIP
DE00-DEFF	56832-57087	I/O EXPANSION #1
DF00-DFFF	57088-57343	I/O EXPANSION #2
E000-FFFF	57344-65535	8K KERNAL

C-64 Memory Map

LOCATION		DESCRIPTION
HEX	DECIMAL	
0000-03FF	0-1023	ZERO PAGE/BASIC POINTERS/STACK/ETC.
0400-07FF	1024-2047	SCREEN RAM
0800-9FF	2048-40959	PROGRAM TEXT AREA
8000-9FFF	32768-40959	8K CARTRIDGE ROM AREA
A000-BFFF	40960-49151	8K BASIC (V2)
C000-CFFF	49152-53247	4K RAM
D000-D3FF	53248-54271	6566 VIDEO CHIP
D400-D7FF	54242-55295	6581 (SID) SYNTHESIZER CHIP
D800-DBFF	55296-56319	1K COLOR NIBBLE
DC00-DCFF	56320-56575	6526 #1 (CIA) I/O CHIP
DD00-DDFF	56576-56831	6526 #2 (CIA) I/O CHIP
DE00-DEFF	56832-57087	I/O EXPANSION #1
DF00-DFFF	57088-57343	I/O EXPANSION #2
E000-FFFF	57344-65535	8K KERNAL

SECTION IV: VIDEO CHIP SPECIFICATIONS

Vic II Chip Register Description

REGISTERS 0-15 ARE PAIRED LIKE 0 AND 1 FOR SPRITES 0-7.

REGISTERS 0-1 CONTROL THE COORDINATE POSITION OF SPRITE ZERO; REGISTER 0 CONTROLS X AXIS AND REGISTER 1 CONTROLS Y AXIS.

REGISTERS 16 IS THE MOST SIGNIFICANT BIT OF THE X COORDINATE OF THE SPRITES, THIS WAY WE CAN MOVE A SPRITE ALL THE WAY ACROSS THE 320 PIXEL X AXIS. BIT 0 CORRESPONDS TO SPRITE ZERO AND SO ON.

REGISTER 17 IS A MULTIFUNCTION REGISTER:

BIT 0-2	SCROLL IN Y POSITION
BIT 3	24/25 ROW SELECT (1=25 ROWS)
BIT 4	NOT USED
BIT 5	BIT MAP MODE
BIT 6	EXTENDED COLOR MODE
BIT 7	RASTER COMPARE

REGISTER 18 IS THE RASTER COMPARE IRQ WRITE REGISTER AND IS READ ONLY.

REGISTERS 19 AND 20 ARE LIGHT PEN LATCHES FOR X AND Y AND ARE READ ONLY.

REGISTER 21 IS THE SPRITE ENABLE REGISTER, EACH BIT SET (0-7) CORRESPONDS TO A SPRITE (0-7).

REGISTER 22 IS ANOTHER MULTIFUNCTION REGISTER:

BIT 0-2	SCROLL IN X POSITION
BIT 3	38/40 COLUMN SELECT (1=40 COLUMNS)
BIT 4	MULTI COLOR MODE
BIT 5-7	NOT USED

REGISTER 23 IS THE SPRITE EXPAND IN Y REGISTER, SETTING THE BIT CORRESPONDING TO A SPRITE DOUBLES THE VERTICAL SIZE (Y) OF THE SPRITE.

REGISTER 24 IS A DUAL FUNCTION REGISTER:

BIT 0	UNSUED
BIT 1-3	CHARACTER SPACE BASE
BIT 4-7	VIDEO MATRIX BASE

REGISTER 25 IS IRQ REGISTER:

BIT 0	RASTER CMP IRQ
BIT 1	IRQ FOR SPRITE-BACKGROUND COLLISION
BIT 2	IRQ FOR SPRITE-SPRITE COLLISION
BIT 3	LIGHT PEN IRQ
BIT 4-7	NOT USED

REGISTER 26 IS IRQ MASK REGISTER: (0=INTERRUPT DISABLED).

REGISTER 27 IS BACKGROUND-SPRITE PRIORITY REGISTER (0=SPRITE HAS PRIORITY).

REGISTER 28 IS THE MULTICOLOR SPRITE SELECT.

REGISTER 29 IS THE SPRITE EXPAND IN X REGISTER (SEE REGISTER 23).

REGISTER 30 IS THE SPRITE-SPRITE COLLISION DETECTION REGISTER.

REGISTER 31 IS THE SPRITE-BACKGROUD COLLISION DETECTION REGISTER.

REGISTERS 32-46 ARE 4 BIT COLOR REGISTERS:

COLOR CODES

VALUE	COLOR
0	BLACK
1	WHITE
2	RED
3	CYAN
4	PURPLE
5	GREEN
6	BLUE
7	YELLOW
8	ORANGE
9	BROWN
10	LT RED
11	GRAY 1
12	GRAY 2
13	LT GREEN
14	LT BLUE
15	GRAY 3

REGISTER	FUNCTION
32	EXTERIOR COLOR
33	BACKGROUND 0
34	BACKGROUND 1
35	BACKGROUND 2
36	BACKGROUND 3
37	SPRITE multicolor reg 0
38	SPRITE multicolor reg 1
39	SPRITE 0 color
40	SPRITE 1 color
41	SPRITE 2 color
42	SPRITE 3 color
43	SPRITE 4 color
44	SPRITE 5 color
45	SPRITE 6 color
46	SPRITE 7 color

Vic II Register Map (chip 6566)

REGISTER	FUNCTION							
01								
02								
03								
04								
05								
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09								
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14								
15								
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17								

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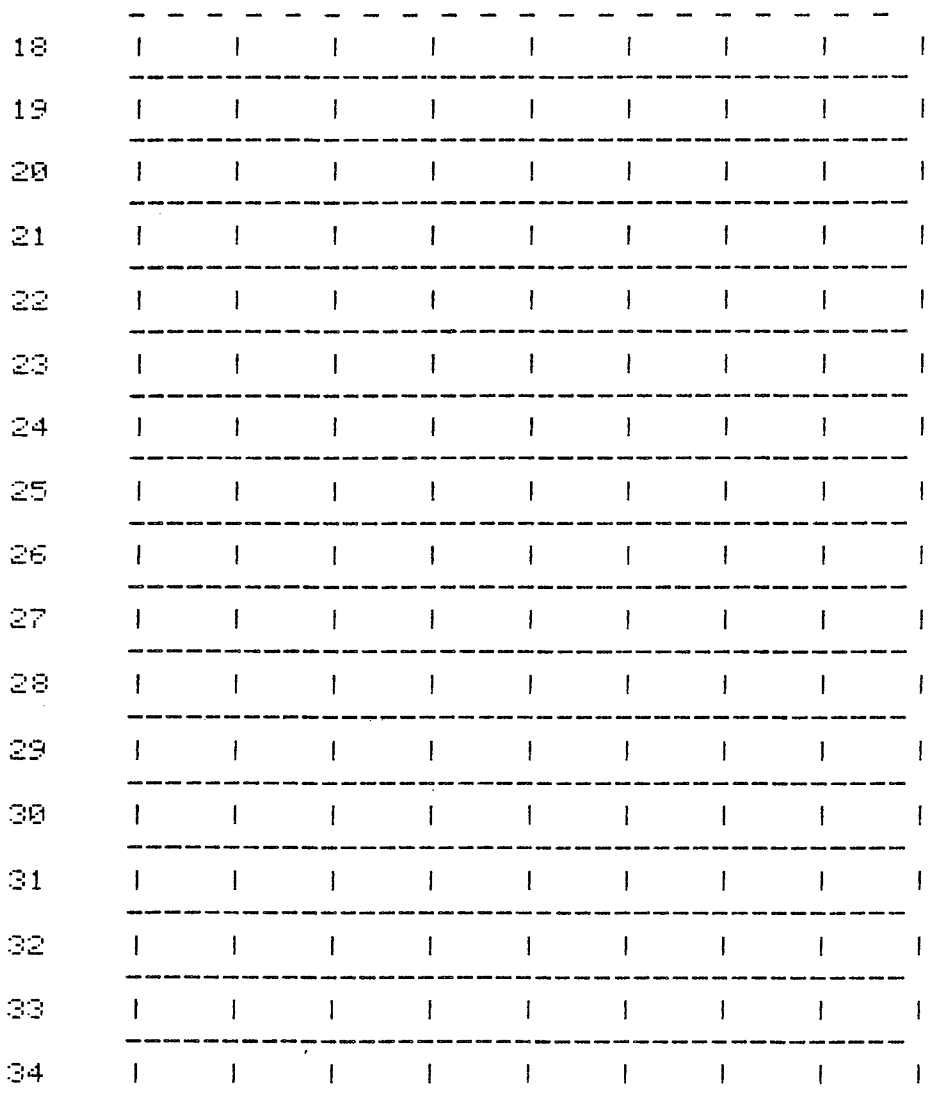
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SECTION V: SOUND CHIP SPECIFICATIONS

Synthesizer Chip Register Description (SID)

THE SID CHIP IS A THREE VOICE POLYPHONIC SYNTHESIZER ON A SINGLE 24 PIN IC. IN ADDITION INDEPENDENT ADSR ENVELOPES FOR EACH VOICE THE SID ALLOWS OSC SYNC, RING MOD, HIGH, LOW ,AND BAND PASS FILTERING AS WELL AS TWO A/D CONVERTERS.

REGISTERS 0-6 CONTROL VOICE 1, 7-13 AND 14-20 ARE ORGANIZED SIMILARLY FOR VOICES 2 AND 3 RESPECTIVELY.
REGISTERS 0 AND 1 (S+0,S+1) REPRESENT THE 16 BIT NUMBER WHICH LINEARLY CONTROLS THE FREQUENCY OF OSC 1.
REGISTER 2 (S+2) AND BITS 0-3 OF REGISTER 3 (S+3) REPRESENT THE 12 BIT NUMBER WHICH CONTROLS THE PULSE WIDTH OF OSC 1.
REGISTER 4 (S+4) IS THE CONTROL REGISTER FOR OSC 1, IT'S BITS SELECT VARIOUS OUTPUT OPTIONS.

BIT 0 GATE BIT: WHEN SET THE ENVELOPE IS TRIGGERED AND ATTACK/DEACAY/SUSTAIN CYCLE BEGINS, WHEN UNSET THE RELEASE CYCLE BEGINS.

BIT 1 SYNC BIT: SYNCHRONIZES OSC 1 TO OSC 3.(2 TO 1 FOR VOICE 2, 3 TO 2 FOR VOICE 3)

BIT 2 RING MOD BIT: REPLACES OSC 1 OUTPUT WITH THE RING MODULATED OUTPUTOF OSC 1 AND OSC 3.(2 AND 1 FOR VOICE 2, 3 AND 2 FOR VOICE 3)

BIT 3 TEST BIT: WHEN SET OSC 1 IS RESET AND LOCKED TO ZERO UNTIL IT IS UNSET.

BIT 4 TRIANGLE WAVEFORM: WHEN SET THE TRIANGLE WAVEFORM OUTPUT IS SELECTED. THE TRIANGLE WAVEFORM IS LOW IN HARMONICS AND HAS A MELLOW, FULTE-LIKE QUALITY.

BIT 5 SAWTOOTH WAVEFORM: WHEN SET THE SAWTOOTH WAVEFORM OUTPUT IS SELECTED. THE SAWTOOTH WAVEFORM IS RICH IN EVEN AND ODD HARMONICS AND HAS A BRIGHT, BRASSY QUALITY.

BIT 6 PULSE WAVEFORM: WHEN SET THE PULSE WAVEFORM OUTPUT OF OSC 1 IS SELECTED. THE HARMONIC QUALITY OF THIS WAVEFORM CAN BE ADJUSTED BY THE PULSE WIDTH REGISTERS, PRODUCING A TONE FROM A BRIGHT, HOLLOW SQUARE WAVE TO A NASAL, REEDY PULSE. SWEEPING THE PULSE PRODUCES A DYNAMIC "PHASING" EFFECT.

BIT 7 NOISE WAVEFORM: WHEN SET THE NOISE OUTPUT WAVEFORM OF OSC 1 IS SELECTED. THIS OUTPUT IS A RANDOM SIGNAL WHICH CHANGES AT THE FREQUENCY OF OSC 1. THE SOUN QUALITY CAN BE VARIED FROM A LOW RUMBLING TO A HISSING WHITE NOISE.

REGISTER 5 (S+5) IS THE ATTACK/DECAY REGISTER.

BIT 4-7 ATTACK RATE(VALUE FROM 0 TO 15, SEE TABLE)

BIT 0-3 DECAY RATE (VALUE FROM 0 TO 15, SEE TABLE)

REGISTER 6 (S+6) IS THE SUSTAIN/RELEASE REGISTER.

BIT 4-7 SUSTAIN RATE(AMPLITUDE VALUE DURING SUSTAIN 0=MIN, 15=MAX)

BIT 0-3 RELEASE RATE(VALUE FROM 0 TO 15, SEE TABLE)

TABLE OF RATES:

VALUE	ATTACK RATE	DECAY/RELEASE RATE
0	2mS	6mS
1	8mS	24mS
2	16mS	48mS
3	24mS	72mS
4	38mS	114mS
5	56mS	168mS
6	68mS	204mS
7	80mS	240mS
8	100mS	300mS
9	250mS	750mS
10	500mS	1.5S
11	800mS	2.4S
12	1S	3S
13	3S	9S
14	5S	15S
15	8S	24S

REGISTERS 21 AND BITS 0-2 OF REGISTER 22 CONTROL THE CUTOFF FREQUENCY FOR THE PROGRAMMABLE FILTER.

FCout=(30+FCin*5.8)Hz

REGISTER 23 IS THE RESONANCE/FILTER CONTROL.

BIT 4-7 CONTROL THE RESONANCE OF THE FILTER. THERE ARE 16 SETTINGS FROM 0 (NO RESONANCE) TO 15 (MAXIMUM RESONANCE).

BIT 0-3 DETERMINE SIGNALS TO BE ROUTED THROUGH FILTER:

BIT 0 VOICE 1, WHEN SET SIGNAL WILL BE PROCESSED, UNSET SIGNAL WILL APPEAR DIRECTLY AT OUTPUT.

BIT 1 SAME FOR VOICE 2

BIT 2 SAME FOR VOICE 3

BIT 3 SAME FOR EXTERNAL INPUT

REGISTER 24 IS THE FILTER MODE/VOLUME CONTROL.

BIT 4-7 SELECTS VARIOUS FILTER MODES.

BIT 4 WHEN SET LOW PASS FILTER IS SELECTED.(COMPONENTS BELOW CUTOFF ARE UNALTERED, COMPONENTS ABOVE CUTOFF ARE ATTENUATED AT 12dB/OCTAVE)

BIT 5 WHEN SET BAND PASS FILTER IS SELECTED.(ALL FREQUENCY COMPONENTS ABOVE AND BELOW CUTOFF ARE ATTENUATED AT 6dB/OCTAVE)

BIT 6 WHEN SET HIGH PASS FILTER IS SELECTED.(COMPONENTS ABOVE CUTOFF ARE UNALTERED, COMPONENTS BELOW CUTOFF ARE ATTENUATED AT 12dB/OCTAVE)

BIT 7 WHEN SET VOICE 3 IS DISCONNECTED FROM AUDIO PATH.(THIS ALLOWS VOICE 3 TO BE USED FOR MODULATION WITHOUT ANY UNDESIREABLE OUTPUT)

BIT 0-3 SELECT 1 OF 16 OVERALL VOLUME LEVELS FOR THE FINAL COMPOSUTE AUDIO OUTPUT

REGISTER 25 IS AN A/D CONVERTER FOR POTX (PIN 24).

REGISTER 26 IS AN A/D CONVERTER FOR POTY (PIN 23).

REGISTER 27 IS OSCILLATOR 3/RANDOM NUMBER GENERATOR REGISTER. IT ALLOWS THE MICROPROCESSOR TO READ THE UPPER 8 OUTPUT BITS OF OSCILLATOR 3. THE CHARACTER OF THE NUMBER GENERATED IS DIRECTLY RELATED TO THE WAVEFORM SELECTED.

IF THE SAWTOOTH WAVEFORM IS SELECTED THE REGISTER PRESENTS A SERIES OF NUMBERS INCREMENTING FORM 0 TO 255 AT A RATE DETERMINED BY OSCILLATOR 3.

IF THE TRIANGLE WAVEFORM IS SELECTED, THE NUMBER WILL INCREMENT FROM 0 TO 255 AND THEN DECREMENT BACK TO ZERO.

IF THE PULSE WAVEFORM IS SELECTED, THE NUMBER WILL JUMP BETWEEN 0 AND 255.

IF THE NOISE WAVEFORM IS GENERATED, A RANDOM NUMBER WILL BE GENERATED.

REGISTER 28 IS THE SAME AS OSCILLATOR 3 BUT IT ALLOWS THE MICROPROCESSOR TO READ THE OUTPUT OF THE VOICE 3 ENVELOPE GENERATOR. THIS OUTPUT CAN BE ADDED TO THE FILTER FREQUENCY TO PRODUCE HARMONIC ENVELOPES, WAH, AND SIMILAR EFFECTS.

SID Register Map (chip 6581)

REGISTER	FUNCTION								
01									
02									
03									
04									
05									
06									
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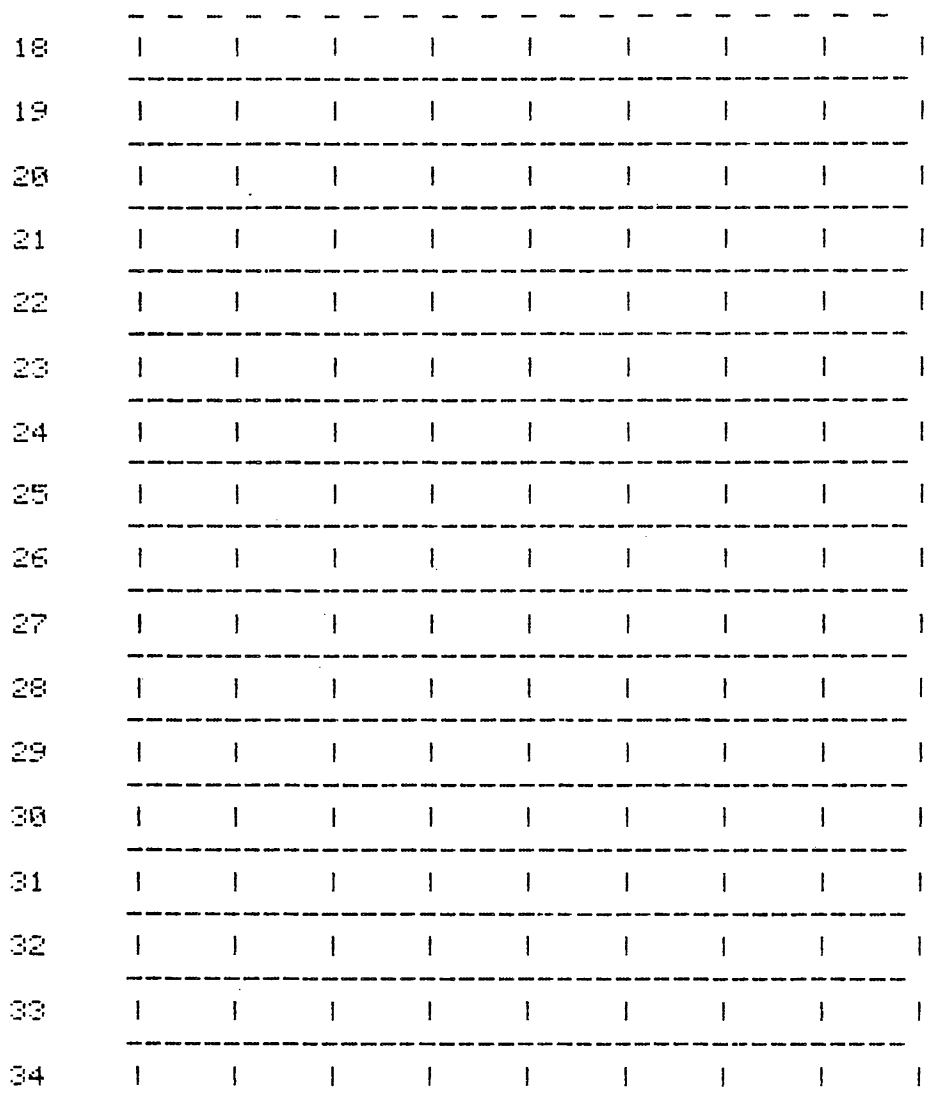
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SECTION VI: UTILITY SOFTWARE & PROGRAMMING AIDS

The following utility software will be provided to you, as a software program developer, to help make it easier for you to develop your **MAX** games:

1. Sprite Editor.
2. Program Character Set Editor. (future)
3. Sound Effects Editor. (future)

In addition Commodore will provide you with a complete set of **HARDWARE REGISTER LABLES**, which will be **REQUIRED FOR USE IN YOUR SOURCE CODE.**

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Michael Tomczyk**